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Two new *Gammarus* species from Benxi Water Cave, China (Crustacea, Amphipoda, Gammaridae)

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Two new *Gammarus* species from Benxi Water Cave, China (Crustacea, Amphipoda, Gammaridae). - Two new *Gammarus* species, *Gammarus pexus* sp. n. and *Gammarus stalagmiticus* sp. n., are described from Benxi Water Cave, Liaoning Province, China. *Gammarus pexus* sp. n. is characterized by the peduncular articles 4 and 5 with groups of long setae and outer margin of outer ramus of uropod 3 only with simple setae. *Gammarus stalagmiticus* sp. n. differs from the congeneric species in the accessory flagellum of antenna 1 with 6 articles and uropod 3 densely provided with plumose and simple setae.

Keywords: Amphipoda - *Gammarus* - taxonomy - new species - China.

INTRODUCTION

Benxi Water Cave (41.3°N, 124.1°E), a karst cave formed some five millions years ago, is located in Benxi County, 35 kilometers from Benxi City of Liaoning Province, China. Stretching approximately 3,000 meters long, covering an area of 36,000 square meters and with a volume of 36,0000 cubic meters, Benxi Water Cave is the longest limestone cave in northern China. The cave's entrance is on the shore of Taizi River, 7 meters high and 25 meters wide in the shape of a crescent. In the cave wonderful views of various shapes of stones can be found, with a crystal-clear underground river running throughout the year.

We know that the freshwater amphipods were already present in Benxi Water Cave about ten years ago, since we received material from Mr Dezeng Liu that was collected from the cave at that time. He had also found some "transparent fish" in the cave. Because his material is not in a good condition, we cannot identify this amphipod from that collection. In August 2003 we finally had the chance to enter Benxi Water Cave, but when we got there we found out that it had changed into a touristical attraction. Neither "transparent fish" nor freshwater Amphipoda was found in the cave. One of the tourguides however indicated that just outside the cave shrimp like animals had been seen, and we did indeed find amphipods. They belong to the genus *Gammarus* and there are two different species.

Gammarus is one of largest epigean freshwater genera of amphipods in the world. Barnard & Barnard (1983) reviewed the freshwater Amphipoda worldwide and

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117 species were listed under the genus *Gammarus*. After 1983, more than 30 species have been recorded by several authors (Karaman & Pinkster, 1987; Morino & Whitman, 1995; Stock *et al.*, 1998), and 28 species have been reported from China (Hou & Li, 2002a, b, c, 2003a, b, c, d, e; Hou, Li & Koenemann, 2002; Hou, Li & Morino, 2002; Hou, Li & Zheng, 2002; Meng *et al.*, 2003). Yet, the diversity of this genus is only partly known in China, and a large area of this country awaits intensive taxonomical surveys.

Detailed drawings of taxonomic characters and descriptions of these two *Gammarus* species are given in the present paper. Differences with related species are discussed.

MATERIAL AND METHODS

The specimens were collected by a fine-mesh hand-net and preserved in 75% ethanol. Prior to dissection, body length was recorded by holding the specimen straight and measuring the distance along the dorsal side of the body from the base of the first antennae to the base of the telson. For each species three to five specimens of each sex were dissected and appendages were mounted on slides according to the methods described by Holsinger (1967). The drawings were made with the aid of a drawing tube mounted on an Olympus BX-41 compound microscope.

All holotypes treated in this study are deposited in the Institute of Zoology, Chinese Academy of Sciences (IZCAS), Beijing, China. Paratypes are deposited in the Institute of Zoology, Chinese Academy of Sciences, Beijing (IZCAS), and in the Muséum d'histoire naturelle, Geneva (MHNG).

TAXONOMY

Gammarus pexus sp. n. Figs 1-4

Material. Holotype, male (IZCAS-I-A0100), outfall of the underground river in Benxi Water Cave, Liaoning Province, collected by Dr Shuqiang Li, August 11, 2003. Paratypes: 35 males, 33 females and 15 juveniles (IZCAS), 10 males and 10 females (MHNG), same data as for the holotype.

Etymology. The species is named for the peduncular articles and flagellum of antenna 2 densely armed with setae.

Diagnosis. Accessory flagellum of antenna 1 with 4 articles. Peduncular articles 4 and 5 of antenna 2 densely with long setae, flagellum with brush-like setae and calceoli absent. Outer margin of outer ramus of uropod 3 with simple setae.

Description of male. Body 12.0 mm in length. Eyes reniform, medium in size (Fig. 1A).

Antenna 1 (Fig. 1J): peduncular articles 1-3 in length ratio 1 : 0.8: 0.5, bearing some groups of marginal setae; flagellum with 32 articles, most of which with aesthescs; accessory flagellum with 4 articles.

Antenna 2 (Figs 1K-M): peduncular article 4 about as long as article 5, bearing 5-8 groups of long setae on anterior margin and 2-5 groups of long setae on posterior margin; flagellum with 11 articles, bearing long brush-like setae, calceoli absent.

Upper lip convex (Fig. 1C), with minute setae.

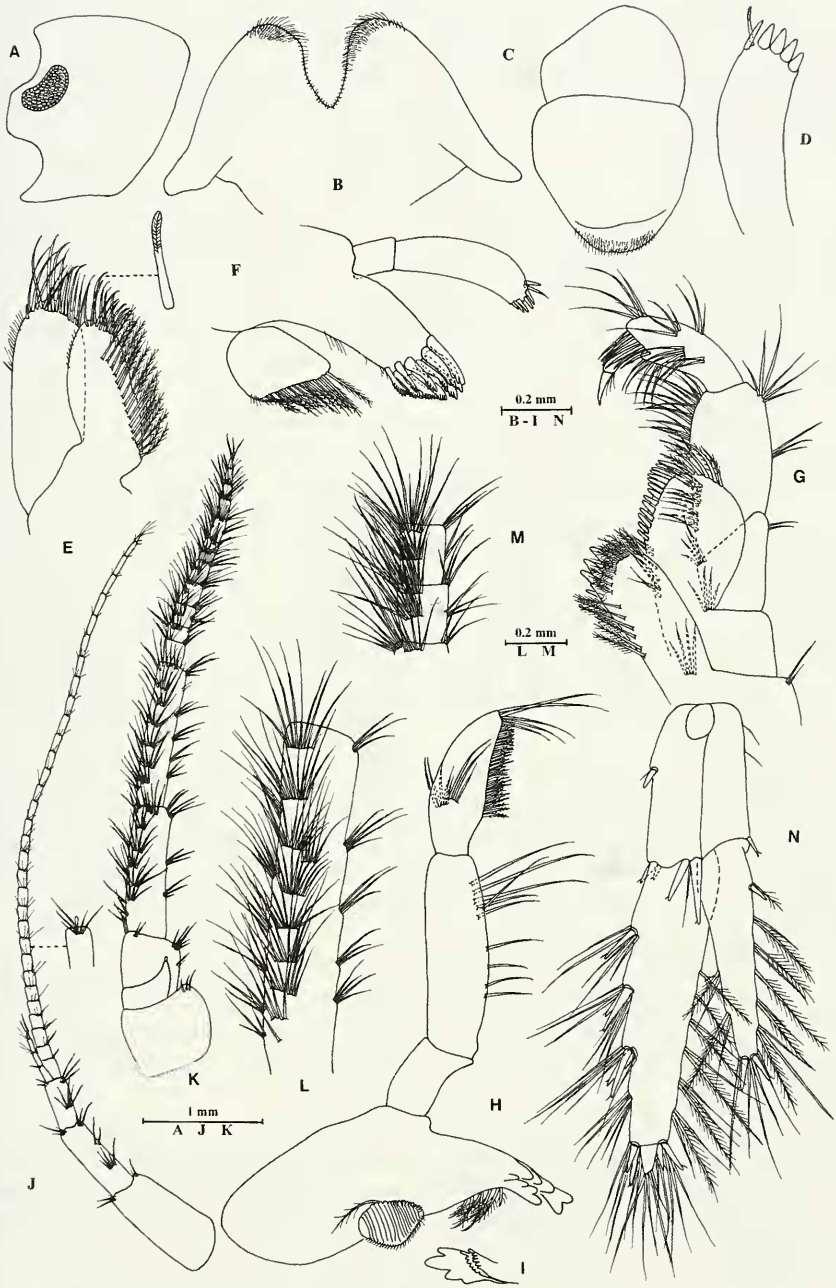

FIG. 1

Gammarus pexus sp. n., holotype, male: A-M; allotype, female: N. A, head; B, lower lip; C, upper lip; D, palp of right maxilla 1; E, maxilla 2; F, left maxilla 1; G, maxilliped; H, left mandible; I, right incisor; J, antenna 1; K, antenna 2; L, peduncular article 5 of antenna 2; M, flagellum of antenna 2; N, uropod 3.

Mandibles (Figs 1H, I): left incisor with 5 teeth; lacinia mobilis with 4 dentitions; article 2 of palp bearing 10 long setae on inner margin, article 3 reaching 75% length of article 2, bearing 5 A-setae on outer surface, 3 B-setae on inner surface, a row of short plumose D-setae and 5 long E-setae. Right mandible incisor with 4 teeth; lacinia mobilis bifurcate, with small crenations.

Lower lip (Fig. 1B): inner lobe absent.

Maxilla 1 (Figs 1D, F): asymmetrical, inner plate bearing 15 plumose setae on inner margin; outer plate with 11 serrated spines apically and some setules medially; article 2 of left palp with 6 spines accompanied by 1 slender seta; article 2 of right palp with 4 blunt spines accompanied by 2 stiff setae.

Maxilla 2 (Fig. 1E): inner plate bearing a diagonal row of 17 plumose setae on inner margin, several long apical setae and some setules on outer margin; outer plate bearing long apical setae and some setules on outer margin.

Maxilliped (Fig. 1G): inner plate bearing 1 subapical spine, 3 apical spines and 6 plumose setae on medial margin; outer plate with 14 spines on inner margin and 5 apical pectinate setae; palp with 4 articles, armed with long setae.

Coxal plates: coxal plates 1-3 subrectangular (Figs 2A-C), bearing 3-4 setules on anterior corner and 1 setule on posterior corner; coxal plate 4 excavated on posterior margin (Fig. 2D), with 2 setules on anterior corner and 5 setules on posterior margin; coxal plates 5 and 6 with small anterior lobe (Figs 3A, B), bearing one or no setule on anterior corner, posterior lobe with 2-3 setules on posterior margin; coxal plate 7 (Fig. 3C) with a group of 5 long setae on anterior margin and 5 setules on posterior margin.

Coxal gills (Figs 2A-D, 3A-C): coxal gills of gnathopod 2 and pereopods 3-7 progressively small.

Gnathopod 1 (Figs 2A, G): basis with long naked setae along anteroproximal and posterior margins; carpus reaching 70% of length of propodus, bearing 2 groups of long setae on anterior margin and a row of long setae on posterior margin; propodus oval, palm strongly oblique, bearing 1 medial spine, 6 spines on posterior margin and 4 spines on medial surface, associated with groups of long medial setae and long marginal setae; dactylus with 1 naked seta on outer margin.

Gnathopod 2 (Figs 2B, H): larger than gnathopod 1, basis similar to that of gnathopod 1, bearing 4 serrated setae accompanied by 4 long naked setae; carpus about 80% of length of propodus; propodus subrectangular, palm transverse, bearing 1 medial spine, 2 spines on lateral posterodistal corner and 2 spines on medial posterodistal corner.

Pereopod 3 (Figs 2C, E): basis with a pair of long setae and 3 groups of short setae on anterior margin and 5 groups of long setae on posterior margin; merus to propodus with long, weakly curled setae on posterior margins, propodus accompanied by 4 short spines on posterior margin; dactylus with 1 plumose seta on outer margin and 2 setae at hinge of nail.

Pereopod 4 (Figs 2D, F): basis with 4 groups of long setae on posterior margin; merus with 5 groups of short setae on posterior margin and 2 short spines on anterior margin; carpus bearing 3 groups of spines accompanied by short setae; propodus bearing 4 single short spines accompanied by short setae; dactylus with 1 plumose seta on outer margin and 2 stiff setae at hinge of nail.

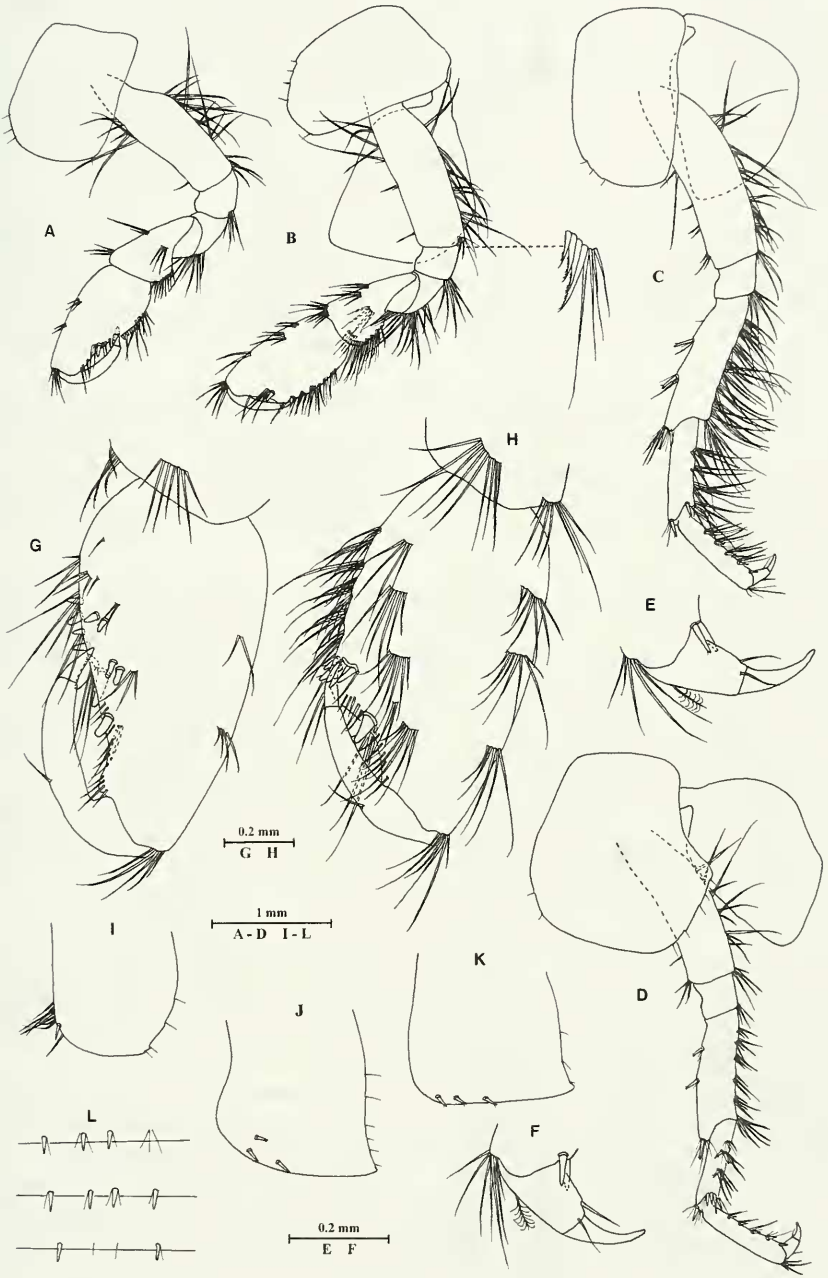

FIG. 2

Gammarus pexus sp. n., holotype, male. A, gnathopod 1; B, gnathopod 2; C, pereopod 3; D, pereopod 4; E, dactylus of pereopod 3; F, dactylus of pereopod 4; G, propodus of gnathopod 1; H, propodus of gnathopod 2; I-K, epimeral plates 1, 2 and 3; L, urosomites (dorsal view).

Pereopod 5 (Figs 3A, H): posterior margin of basis nearly straight, bearing a row of 12 setules, anterior margin with 4 single spines associated with setules; merus with 3 groups of short setae on anterior margin and 2 single spines on posterior margin; carpus with 2 pairs of spines accompanied by short setae on anterior margin and 2 groups of 3 spines on posterior margin; propodus with one single and 3 groups of spines on anterior margin and a group of long setae on posterior margin; dactylus with 1 plumose seta on outer margin and 2 setae at hinge of nail.

Pereopod 6 (Figs 3B, I): basis longer than that of pereopod 5, weakly attenuated distally on posterior margin, bearing a row of 14 setules, anterior margin with 4 single spines; merus and carpus with 2 groups of spines accompanied by short setae on anterior margins; propodus with 4 groups of spines on anterior margin and 3 groups of setae on posterior margin; dactylus with 1 plumose seta on outer margin and 2 setae at hinge of nail.

Pereopod 7 (Figs 3C, J): basis processed medially on posterior margin, bearing a row of 12 setules, anterior margin with 5 long setae proximally and 4 single spines; merus and carpus with 2 groups of spines on anterior margins accompanied by short setae; propodus with 4 groups of spines on anterior margin and one single seta and 2 groups of setae on posterior margin; dactylus bearing 1 plumose seta on outer margin and 2 stiff setae at hinge of nail.

Epimeral plates: each posterior margin with 3-6 setules; plate 1 ventrally rounded (Fig. 2I), bearing a short spine and 8 setae on anteroventral corner; plates 2 and 3 weakly pointed posterodistally (Figs 2J, K), bearing 1 subventral spine and 2 spines on ventral margin in plate 2; plate 3 with 3 spines on ventral margin.

Pleopods (Fig. 3F): pleopods 1-3 subequal in length, peduncles bearing 2 retinacula accompanied by 3 setae on anterodistal corner, and several long setae on medial surface; inner and outer rami with 15-20 articles, armed with plumose setae.

Urosomites (Fig. 2L): dorsally flat, urosomite 1 bearing 3 single spines accompanied by short setules and a group of 3 short setae on posterodorsal margin; urosomite 2 bearing 4 single spines accompanied by short setules; urosomite 3 bearing 2 single spines on both sides and 2 single setules medially.

Uropod 1 (Fig. 3D): outer ramus 52% and inner ramus 65% of length of peduncle, peduncle bearing 1 dorsolateral spine, with 2 spines on outer margin, 2 spines on inner margin, 2 spines on laterodistal corner and 1 spine on medial distal corner; inner ramus with 2 spines on inner margin; outer ramus with 2 spines on inner margin and 2 spines on outer margin.

Uropod 2 (Fig. 3E): outer ramus 69% and inner ramus 88% of length of peduncle, peduncle bearing marginal spines; inner ramus with 2 spines on outer margin; outer ramus with 2 spines on outer margin and 1 spine on inner margin.

Uropod 3 (Fig. 3G): peduncle bearing 1 spine on lateral margin and 4 long setae on medial margin, with a pair of spines apico-laterally, 1 spine apico-medially and a pair of spines on the mid-ventral margin; inner ramus about 75% of length of article 1 of outer ramus, bearing 3 marginal spines and 1 distal spine accompanied by long plumose setae; article 1 of outer ramus with 4 pairs of spines on outer margin and 2 pairs of spines distally, article 2 about as long as adjacent spines, 8% of length of article 1; both margins of inner ramus and inner margin of outer ramus armed with plumose setae, while outer margin of outer ramus only has simple setae.

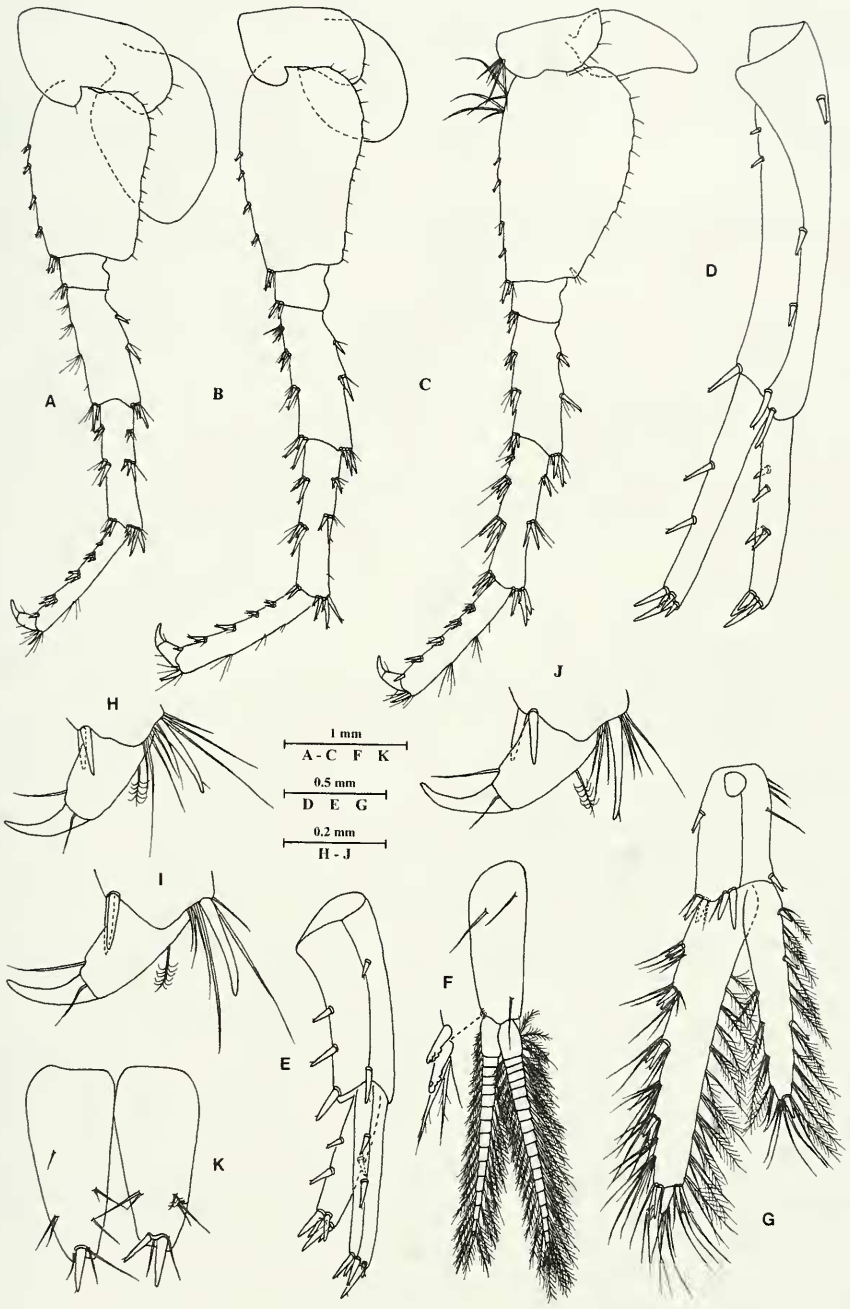

FIG. 3

Gammarus pexus sp. n., holotype, male. A, pereopod 5; B, pereopod 6; C, pereopod 7; D, uropod 1; E, uropod 2; F, pleopod 1; G, uropod 3; H-J, dactyli of peroepods 5, 6 and 7; K, telson.

Telson deeply cleft (Fig. 3K), left lobe bearing 1 distal spine, right lobe bearing 2 distal spines, both with some facial setae.

Description of female. Body 9.2 mm in length, ovigerous, with 28 eggs.

Gnathopod 1 (Fig. 4F): propodus ovate, bearing long and short setae on palmar margin, 7 spines on posterior margin associated with long setae; dactylus bearing 1 seta on outer margin.

Gnathopod 2 (Fig. 4G): propodus subrectangular, palm truncate, bearing 2 spines on lateral posterodistal corner and 2 spines on medial posterodistal corner, with 5 groups of long setae on posterior margin and 6 groups of long setae on medial surface.

Pereopods 3 and 4 with long straight setae on posterior margin (Figs 4A, B). Merus and carpus of pereopods 5-7 (Figs 4C-E) with 2-3 groups of spines accompanied by long setae on anterior and posterior margins.

Uropod 3 (Fig. 1N): similar to that of male, inner ramus 75% of length of article 1 of outer ramus, bearing 1 marginal spine and 2 distal spines; outer ramus bearing 3 pairs of spines on outer margin; inner margin of outer ramus and both margins of inner ramus with plumose setae, while outer margin of outer ramus with simple setae.

Telson deeply cleft (Fig. 4H), each lobe bearing 2-3 distal spines and some facial setae.

Oostegites on gnathopod 2 to pereopod 5 (Fig. 4I), progressively smaller, fringed with long marginal setae.

Variation. Epimeral plate 1 bearing one spine or no spine on anteroventral corner. Each lobe of telson with 1-3 distal spines and variable setae.

Remarks. *Gammarus pexus* sp. n. is readily distinguishable from its congeners by the setose antenna 2 and outer margin of outer ramus of uropod 3 with simple setae. *G. pexus* is similar to *G. pulex* (Linnaeus, 1758) (data based on Karaman & Pinkster, 1977) in the flagellum of antenna 2 which is densely set with brush-like setae and the ratio of inner and outer ramus being about 75 : 100. *G. pexus* differs from *G. pulex* (*G. pulex* character states in parentheses) by (1) slender body, 9-11 mm in length (stout, 15-23 mm); (2) peduncular articles 4 and 5 densely set with groups of long setae and calceoli absent (with tufts of short setae and calceoli present); (3) anterior margins of merus and carpus of pereopods 5-7 bearing short setae (without setae); (4) outer margin of outer ramus only with simple setae (densely set with plumose setae).

G. pexus sp. n. is also similar to *G. nipponensis* Ueno, 1940 in (1) peduncular articles 4 and 5 and flagellum of antenna 2 densely set with setae, and calceoli absent; (2) anterior margins of merus and carpus of pereopods 5-7 with short setae; (3) the ratio of inner and outer ramus being about 75 : 100, and outer margin of outer ramus with simple setae. *G. pexus* can be distinguished from *G. nipponensis* (character states in parentheses) by (1) eyes relatively large, reniform (small, subrounded); (2) terminal article of outer ramus of uropod 3 about as long as adjacent spines, 8% of length of article 1 (distinctly shorter than adjacent spines, less than 5% of lengths of article 1); (3) pereopod 3 densely with long weakly curled setae on posterior margin (with less straight setae); (4) urosomites with short setae (relatively long setae).

Distribution. The new species is only known from the outfall of the underground river in Benxi Water Cave. The water temperature is 6-10? throughout the year and PH is 6.

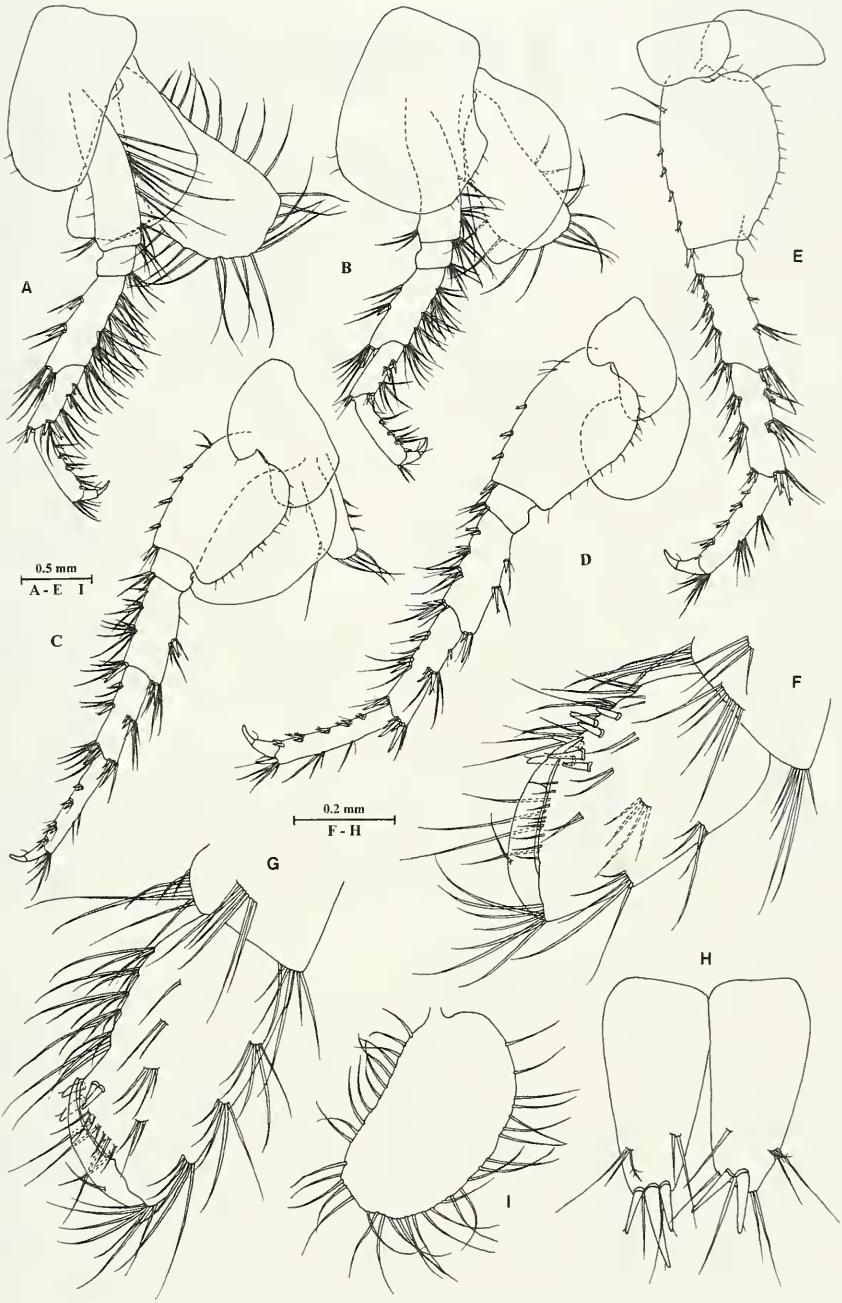

FIG. 4

Gammarus pexus sp. n., allotype, female. A, pereopod 3; B, pereopod 4; C, pereopod 5; D, pereopod 6; E, pereopod 7; F, propodus of gnathopod 1; G, propodus of gnathopod 2; H, telson; I, oostegite of gnathopod 2.

Gammarus stalagmiticus sp. n. Figs 5-8

Material. Holotype, male (IZCAS-I-A0089), outfall of the underground river in Benxi Water Cave, Liaoning Province, collected by Dr Shuqiang Li, August 11, 2003. Paratypes: 40 males, 8 females and 8 juveniles (IZCAS), 10 males and 7 females (MHNG), same data as for the holotype.

Other material: 271 males, 95 females (35 ovigerous) and 95 juveniles (IZCAS), a small branch of Taizi River that connected to outfall of the underground river in Benxi Water Cave, Liaoning Province, collected by Dr Shuqiang Li, August 11, 2003.

Etymology. The specific name is derived from the biotope of the holotype, Benxi Water Cave, where the well developed stalactites and stalagmites on the roof and walls take on various shapes and forms.

Diagnosis. Accessory flagellum of antenna 1 with 5-7 articles. Peduncular articles 4 and 5 of antenna 2 poorly with long setae, flagellum with short setae, calceoli present. Pereopods 5-7 almost without setae on anterior margin. Uropod 3 densely set with plumose and simple setae. Telson with dorsolateral spine.

Description of male. Body 16.2 mm in length. Eyes reniform, medium in size (Fig. 5A).

Antenna 1 (Fig. 5B): peduncular articles 1-3 in length ratio 1 : 0.67 : 0.38, bearing some setae on posterior margin; flagellum with 41 articles, most of which with aesthetascs; accessory flagellum with 5-7 articles.

Antenna 2 (Fig. 5C): peduncular article 4 about as long as article 5, bearing 3-4 groups of short setae along anterior margin, 2-4 groups of short setae along posterior margin and 3-4 groups of short setae on medial surface; flagellum with 16 articles, bearing short setae, calceoli present.

Upper lip convex (Fig. 5D), with minute setae.

Mandibles (Figs 5E-G): left incisor with 5 teeth; lacinia mobilis with 4 teeth; article 2 of palp bearing 14 long setae on inner margin, article 3 reaching 70% of length of article 2, bearing 7 A-setae on outer surface, 6 B-setae on inner surface, a row of short plumose D-setae and 6 E-setae. Right mandible incisor with 4 teeth; lacinia mobilis bifurcate, with small crenations; article 3 of palp with two groups of A-setae and two groups of B-setae.

Lower lip (Fig. 5H): inner lobe absent.

Maxilla 1 (Figs 5I-K): asymmetrical, inner plate bearing 15 plumose setae on inner margin and many setules on medial surface; outer plate bearing 11 serrated spines apically and some setules medially; article 2 of left palp with 8 spines accompanied by 4 setae; article 2 of right palp with 6 blunt spines accompanied by 1 seta.

Maxilla 2 (Fig. 5L): inner plate bearing a diagonal row of 14 plumose setae on inner margin, several long apical plumose setae and some setules on outer margin; outer plate bearing long apical setae and some setules on outer margin.

Maxilliped (Figs 5M, N): inner plate bearing 1 subapical spine, 3 apical spines and a row of plumose setae on medial and apical margins; outer plate bearing a row of 12-15 blade spines and 5 apical pectinate setae; palp with 4 articles, article 4 claw-formed, bearing 1 seta on outer margin and 5 setae on inner margin.

Coxal plates: coxal plate 1 weakly dilated distally (Fig. 6A), bearing 1 setule on anterior corner and 1 setule on posterior corner; coxal plates 2 and 3 subrectangular (Figs 6B, 7A), bearing 2 setules on anterior corner and 1 setule on posterior corner;

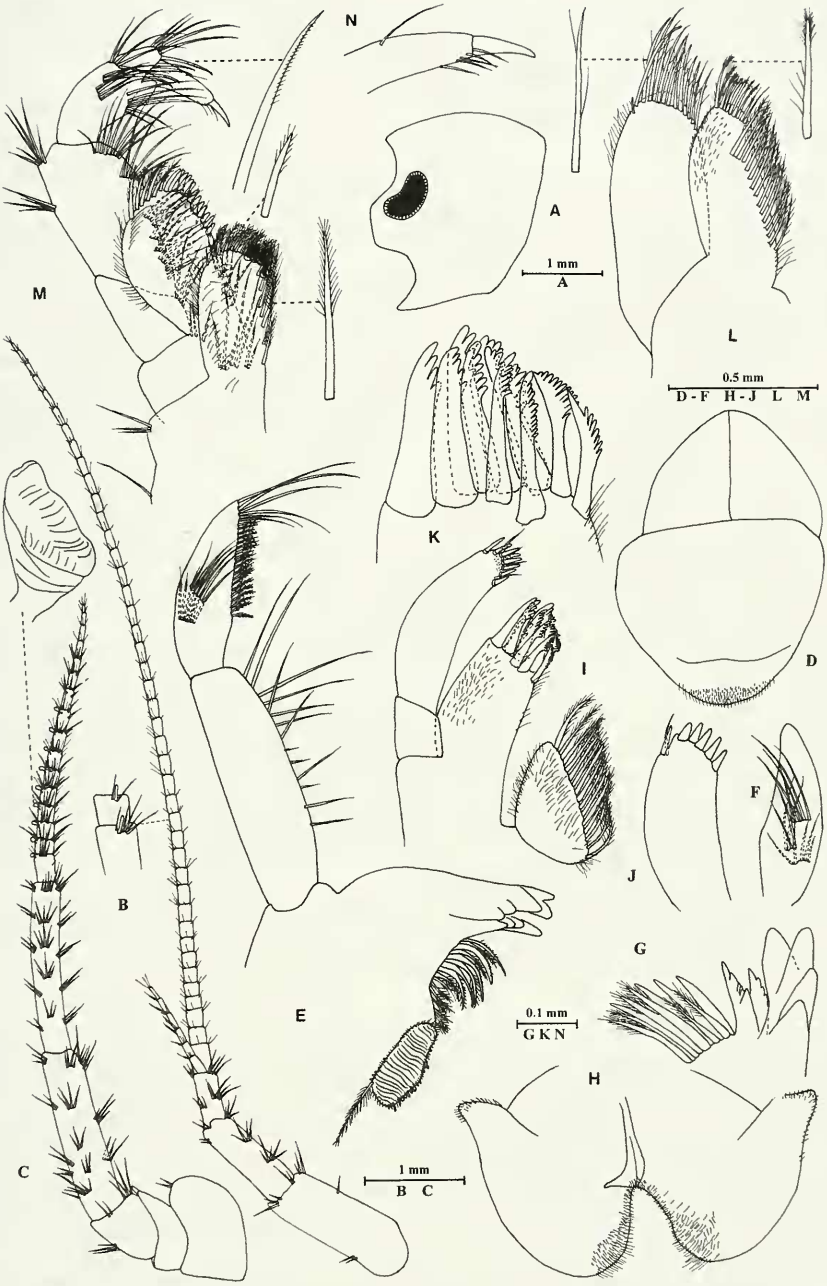

FIG. 5

Gammarus stalagmiticus sp. n., holotype, male. A, head; B, antenna 1; C, antenna 2; D, upper lip; E, left mandible; F, palp of right mandible; G, incisor of right mandible; H, lower lip; I, left maxilla 1; J, palp of right maxilla 1; K, outer plate of left maxilla 1; L, maxilla 2; M, maxilliped; N, palp article 4 of maxilliped.

coxal plate 4 with excavation on posterior margin (Fig. 7B), bearing 2 setules on anterior corner and 4 setules on posterior margin; coxal plate 5-7 shallow (Figs 7C-E), with 2-3 setules on posterior margin.

Coxal gills (Figs 6B, 7A-E): coxal gills of gnathopod 2 and pereopods 3-7 progressively smaller.

Gnathopod 1 (Figs 6A, C): basis with long naked setae along anteroproximal and posterior margins, and several serrated setae distally; carpus reaching 70% of length of propodus, bearing 2 groups of setae on anterior margin and a row of long setae on posterior margin; propodus pyriform, palm strongly oblique, bearing 1 medial spine, 11 spines on posterior margin and 8 spines on medial surface, associated with groups of long medial setae and long marginal setae; dactylus with 1 seta on outer margin.

Gnathopod 2 (Figs 6B, D): larger than gnathopod 1, basis similar to that of gnathopod 1; carpus reaching 82% length of propodus, with parallel margin; propodus subrectangular, palm tranverse, bearing 1 medial spine, 3 spines on lateral posterodistal corner and 3 spines on medial posterodistal corner; dactylus with 1 seta on outer margin.

Pereopod 3 (Figs 7A, F): basis with a pair of long setae on anterior margin and about 25 long setae on posterior margin; merus to propodus with long weakly curled setae on posterior margin, propodus accompanied by 5 single short spines on posterior margin; dactylus with 1 plumose seta on outer margin and 2 setae at hinge of nail.

Pereopod 4 (Figs 7B, G): basis with 1 long seta on anterior margin and many long setae on posterior margin; merus to propodus with long straight setae on posterior margin, propodus with 5 single short spines on posterior margin.

Pereopod 5 (Figs 7C, H): posterior margin of basis nearly straight, bearing a row of 10 setules, anterior margin bearing 1 long seta and 5 single short spines; merus to propodus with 2-4 groups of spines accompanied by short setae, setae not longer than spines; dactylus with 1 plumose seta on outer margin and 2 stiff setae at hinge of nail.

Pereopod 6 (Figs 7D, I): longer than pereopod 5, basis elongate, weakly attenuated distally on posterior margin, bearing a row of 15 setules, anterior margin with 6 single short spines; merus to propodus bearing 3-5 groups of spines, almost without setae.

Pereopod 7 (Figs 7E, J): basis processed medially on posterior margin, bearing a row of 16 setules, anterior margin bearing a group of 4 long setae proximally and 6 single short spines, inner surface with 1 short spine accompanied by 2 setules on posterodistal corner; the armature of merus to propodus similar to that of pereopod 6.

Epimeral plates (Figs 8A-C): each posterior margin bearing 3-5 setules; plate 1 ventrally horizontal, bearing 10 setae on anteroventral corner; plates 2 and 3 with blunt posterodistal corner, bearing 2 and 3 spines on ventral margins in plate 2 and 3, respectively.

Pleopods 1-3 subequal in length (Fig. 8E), peduncles bearing 2 retinacula accompanied by 3 setae on anterodistal corner, and a few long setae on medial surface; inner and outer rami with about 20-30 articles, both fringed with plumose setae.

Urosomites dorsally flat (Fig. 8D), urosomites 1 and 2 bearing 4 groups of spines accompanied by setae on posterodorsal margins; urosomite 3 bearing 2 pairs of

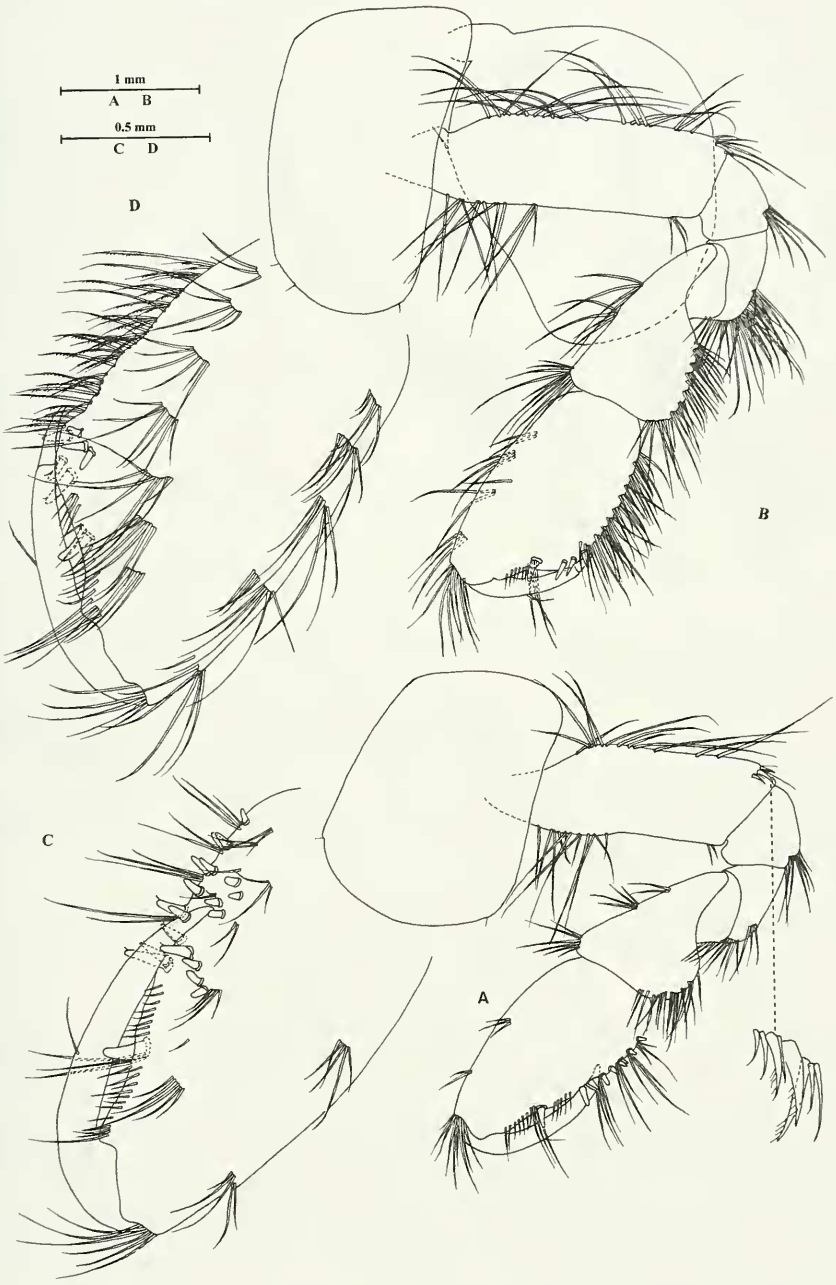

FIG. 6

Gammarus stalagmiticus sp. n., holotype, male. A, gnathopod 1; B, gnathopod 2; C, propodus of gnathopod 1; D, propodus of gnathopod 2.

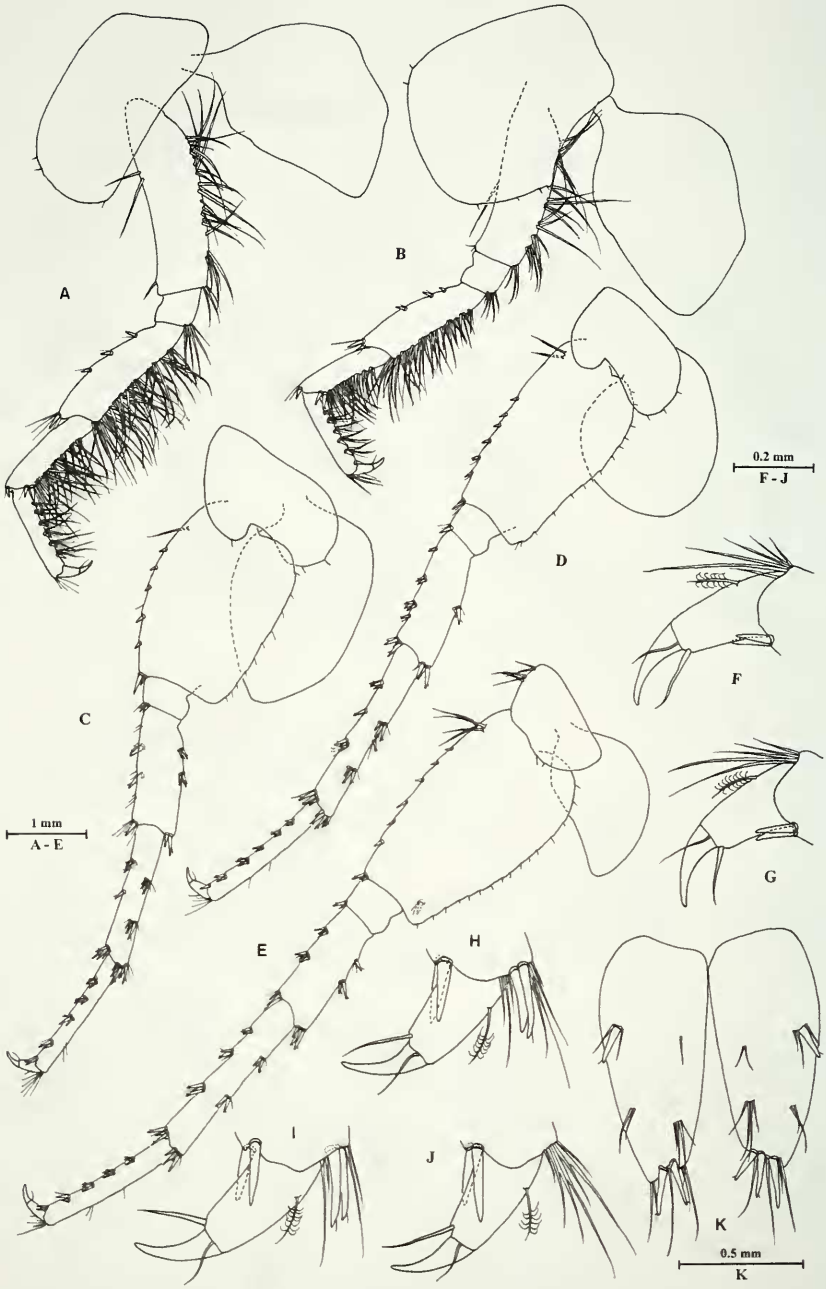

FIG. 7

Gammarus stalagmiticus sp. n., holotype, male. A, pereopod 3; B, pereopod 4; C, pereopod 5; D, pereopod 6; E, pereopod 7; F, dactylus of pereopod 3; G, dactylus of pereopod 4; H, dactylus of pereopod 5; I dactylus of pereopod 6; J, dactylus of pereopod 7; K: telson.

setae medially, 2 spines accompanied by 4 setae in the left and 1 single spine accompanied by 2 setae in the right.

Uropod 1 (Fig. 8F): outer ramus 58% and inner ramus 67% of length of peduncle, peduncle bearing 1 dorsolateral spine, 3 spines on outer margin, 2 spines on inner margin, 2 spines on laterodistal corner and 1 spine on medial distal corner; inner ramus with 3 spines on inner margin; outer ramus with 2 spines on outer margin and 3 spines on inner margin.

Uropod 2 (Fig. 8G): outer ramus 60% and inner ramus 80% of length of peduncle, peduncle bearing marginal spines; inner ramus with 1 spine on outer margin and 3 spines on inner margin; outer ramus with 2 spines on inner margin and 2 spines on outer margin.

Uropod 3 (Fig. 8H): peduncle bearing 1 spine on lateral margin, 3 long setae on medial margin, 3 spines on mid-ventral margin, 3 spines on medial ventral margin and 2 spines apico-medially; inner ramus about 80% of length of article 1 of outer ramus, bearing 3 spines on inner margin and a pair of distal spines; article 1 of outer ramus with 1-2-2 spines on outer margin and two pairs of distal spines, article 2 about 5% of length of article 1; inner and outer margins of both rami densely armed with plumose and simple setae.

Telson deeply cleft (Fig. 7K), each lobe bearing 1 basolateral spine, 2-3 distal spines and some facial setae.

Description of female. Body 14.0 mm in length, ovigerous, with 25 eggs.

Gnathopod 1 (Fig. 8J): propodus ovate, palm not as oblique as that of male, bearing long and short setae on palmar margin, 12 spines on posterior margin associated with long setae; dactylus with 1 seta on outer margin.

Gnathopod 2 (Fig. 8K): propodus subrectangular, palm truncate, bearing 3 spines on lateral posterodistal corner and 2 spines on medial posterodistal corner, with groups of serrate setae on posterior margin, 9 groups of long setae on medial surface.

Uropod 3 (Figs 8L, M): inner ramus reaching 83% of length of article 1 of outer ramus, bearing 2 spines on inner margin and 1 distal spine; outer ramus bearing 2-1-2 spines on outer margin; both rami armed densely armed with plumose and simple setae.

Oostegites present on gnathopod 2 (Fig. 8I) and pereopods 3-5, second oostegite broad, bearing long marginal setae.

Variation. Accessory flagellum of antenna 1 with 5-7 articles, but never with less than 4 articles. Epimeral plates 2 and 3 bearing 2-4 short spines on ventral margins. The ratio of inner ramus and article 1 of outer ramus varies, from 70-90%. Each lobe of telson bearing 2-3 spines accompanied by various setae.

Remarks. *Gammarus stalagmiticus* sp. n. is similar to *G. nekkensis* Uchida, 1935 (data based on Karaman, 1989) in (1) accessory flagellum of antenna 1 with 5-7 articles, not less than 4 articles; (2) peduncular articles of antenna 2 with short setae, and calceoli present; (3) pereopod 3 densely set with long weakly curled setae. *G. stalagmiticus* differs from *G. nekkensis* (character states in parentheses) by (1) eyes reniform, relatively large (small, semicircular); (2) inner ramus reaching 80% of length of article 1 of outer ramus of uropod 3 (50%); (3) outer margin of outer ramus densely

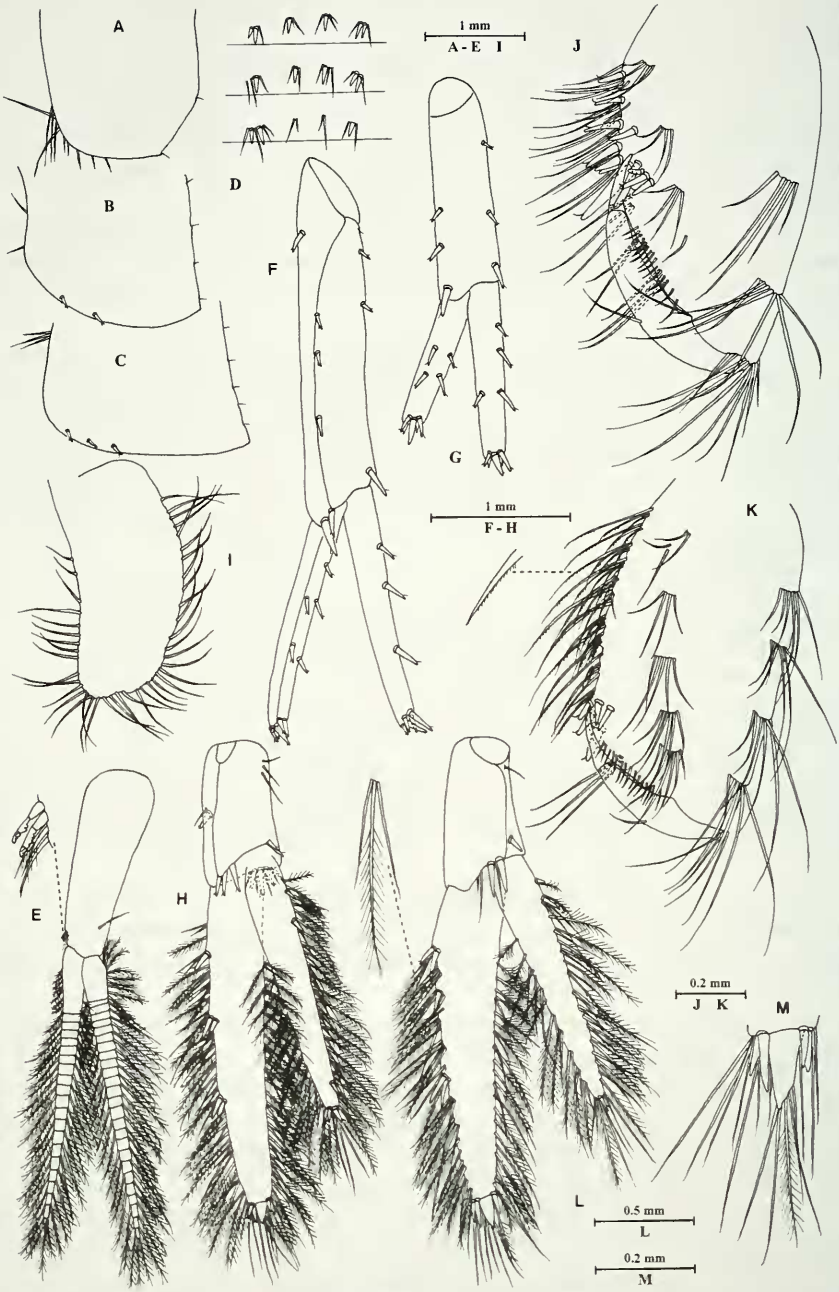

FIG. 8

Gammarus stalagmiticus sp. n., holotype, male: A-H; allotype, female: I-M. A, epimeral plate 1; B, epimeral plate 2; C, epimeral plate 3; D, urosomites; E, pleopod 1; F, uropod 1; G, uropod 2; H, uropod 3; I, oostegite of gnathopod 2; J, propodus of gnathopod 1; K, propodus of gnathopod 2; L, uropod 3; M, terminal article of uropod 3.

armed with plumose and simple setae (with numerous long simple setae); (4) the uropods 1 and 2 reaching half of outer ramus of uropod 3 (reaching the end of peduncle of uropod 3).

G. stalagmiticus sp. n. is also similar to *G. decorosus* Meng *et al.*, 2003 in (1) pereopods 3 and 4 with long setae on posterior margins; (2) epimeral plates 2 and 3 with blunt posterodistal corners; (3) inner ramus reaching more than 70% of length of outer ramus, and both rami armed with plumose and simple setae. *G. stalagmiticus* is distinguished from *G. decorosus* (character states in parentheses) in (1) accessory flagellum of antenna 1 with 5-7 articles (4 articles); (2) antenna 2 calceoli present (absent); (3) telson with a few short distal and facial setae (many long distal and facial setae).

G. pexus sp. n. and *G. stalagmiticus* sp. n. apparently are able to coexist in the same environment. *G. pexus* is distinguished from *G. stalagmiticus* (character states in parentheses) in (1) body slender, 8-12 mm in length (stout 15-18 mm); (2) accessory flagellum of antenna 1 with 4 articles (5-7 articles, no less than 4 articles); (3) peduncular articles 4 and 5 armed with groups of long setae, flagellum with brush-like setae, and calceoli absent (peduncular articles with short setae, flagellum without brush-like setae, and calceoli present); (4) outer margin of outer ramus only with simple setae (densely with plumose and simple setae).

Distribution. The new species can be found in the outfall of the underground river in Benxi Water Cave and a small branch of Taizi River that connected to this outfall. Distribution in Taizi River, Liaoning Province is possible.

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